MODIS Semi-Annual Report
Snow and Ice Project
Reporting Period: January - July 2000
Submitted by: Dorothy K. Hall/974

Papers and abstracts:

Barton, J.S., "Remote sensing of fractional snow cover using MODIS data, Proceedings of the 57th Annual Eastern Snow Conference, 17-19 May 2000, Syracuse, NY, in press.

Hall, D.K., A.B. Tait, J.L. Foster, A.T.C. Chang and M. Allen, "Comparison of snow-cover maps from multiple satellite data sets," Proceedings of the 56th Annual Eastern Snow Conference, 2-4 June 1999, Fredericton, B.C., pp. 71-74.

Hall, D.K., A.B. Tait, J.L. Foster, A.T.C. Chang and M. Allen, "Intercomparison of satellite-derived snow-cover maps," Annals of Glaciology, in press.

Hall, D.K., J.L. Foster, V.V. Salomonson, A.G. Klein and J.Y.L. Chien,"Development of a Technique to Assess Snow-Cover Mapping Accuracy from Space," IEEE Transactions on Geoscience and Remote Sensing, accepted for publication.

Hall, D.K., G.A. Riggs, V.V. Salomonson and G.R. Scharfen, Earth Observing System (EOS) Moderate Resolution Imaging Spectroradiometer (MODIS) Snow-Cover Maps, Proceedings of the IAHS Hydrology 2000 Conference, 2-8 April 2000, Santa Fe, NM, in press.

Hall, D.K., G.A. Riggs, V.V. Salomonson and G.R. Scharfen, "Early Results from the Moderate Resolution Imaging Spectroradiometer (MODIS) Global Snow and Ice Cover Products," Proceedings of IGARSS'00, July 24-28, Honolulu, HI, in press.

Klein, A.G. and D.K. Hall, "Snow albedo determination using the NASA MODIS instrument," Proceedings of the 56th Annual Eastern Snow Conference, 2-4 June 1999, Fredericton, B.C., pp. 77-86.

Klein, A.G., D.K. Hall and A. Nolin, "Development of a prototype snow algorithm for the NASA MODIS instrument," Proceedings of the 57th Annual Eastern Snow Conference, 17-19 May 2000, Syracuse, NY, in press.

Scharfen, G.R., Hall, D.K., S.J.S. Khalsa, J.D. Wolfe, M.C. Marquis, G.A. Riggs and B. McLean, "Accessing the MODIS snow and ice products at the NSIDC DAAC, "Proceedings of IGARSS'00, 23-28 July 2000, Honolulu, HI, in press.

Tait, A.B., D.K. Hall, J.L. Foster and R. Armstrong, Tait, A.B., Hall, D.K., Foster, J.L., and Armstrong, R.L. Utilizing multiple datasets for snow cover mapping," Remote Sensing of Environment.

Tait, A.B., J.S. Barton and D.K. Hall, A Prototype MODIS-SSM/I Snow Mapping Method, Proceedings of the IAHS Hydrology 2000 Conference, 2-8 April 2000, Santa Fe, NM, in press.

Presentations:

Barton, J.S., "Remote sensing of fractional snow cover using MODIS data," Eastern Snow Conference, Syracuse, NY, 17 May 2000.

Hall, D.K., "MODIS snow and ice products – an update," PODAG, Boulder, CO, 7 February 2000.

Hall, D.K., "Earth Observing System (EOS) Moderate Resolution Imaging Spectroradiometer (MODIS) global snow and ice cover maps," Hydrology 2000 Symposium, Santa Fe, NM, 3 April 2000.

Hall, D.K., "Early MODIS snow-cover product accuracy studies," to USRA graduate students, GSFC, 5 June 2000.

Hall, D.K., "Preliminary results of the MODIS snow and ice products," MODIS Team meeting, College Park, MD, 7 June 2000.

Klein, A.B., "Development of a prototype snow albedo algorithm for the NASA MODIS instrument," Eastern Snow Conference, Syracuse, NY, 17 May 2000.

Riggs, G.A., "Early analysis of the EOS MODIS snow cover data products," Eastern Snow Conference, Syracuse, NY, 17 May 2000.

Algorithm work – G. Riggs/RDC

The MODIS snow and sea ice data products have been evaluated and analyzed since the first data became available on 25 February 2000. The ECS EDG has been used to order data from the NSIDC and GES DAACs and the MEDOS has been used to order from MODAPS. The MODIS band 6 non-functional detector problem effect in the snow and sea ice products was analyzed. Collaborated with UWCM group on investigation of cloud masking results over snow and ice.

The MODIS Snow Users Guide was completed and posted on the SCF web page and made public on 23 February 2000.

The MODIS sea ice algorithm Version 2.3.0 (MOD_PR29 V2.3.0) was coded, tested and delivered to SDST on 7 February 2000.

A daily MODIS snow climate modeling grid (CMG) product was generated from MODIS data products and was analyzed.

Revisions for the next version of the MODIS snow data product, MOD10_L2 V2.4.1, were identified based on analysis of currently produced MODIS snow products, and on analysis and changes of MODIS input data products.

IDL procedures for perusal, quality assurance investigation, analysis and for mapping and projection of MODIS snow and sea ice data products were revised or built as needed to support analysis.

A validation investigator on cruise in Amundsen Sea during March was supported.

Field and Aircraft Experiment – D. Hall

Field and MODIS Airborne Simulator (MAS) aircraft experiments were planned at three sites for February and March of 2000. However, due to a dearth of snow cover in the two mid-western U.S. study areas, a field experiment was only possible at the Keene, New Hampshire site. Concomitant with NASA ER-2 and MODIS overpasses, snow cover, depth, air temperature and canopy density were measured at various sites near Keene.

Preliminary results show a 90% correspondence between the National Operational Hydrologic Remote Sensing Center (NOHRSC) 1-km resolution snow-cover product and the 500-m resolution MODIS snow map, both acquired on March 6, 2000, which was the day of the ER-2 overflight.

The MODIS-derived and NOHRSC maps agree very well except in south-central New York where meteorological data show that the MODIS data is the more accurate. A journal paper is being prepared on this topic.

Fractional snow cover – J. Barton

The Snowmap algorithm creates a map of snow covered, 500m by 500m pixels within the area viewed by the MODIS instrument. In order to increase the value of the product to climate modelers and hydrologists, several methods are being investigated to determine the percentage of snow-cover within a given pixel (fractional snow cover). This paper describes the development of one of these methods. Expanding on the use of the Normalized Difference Snow Index already in use by the Snowmap algorithm for snow mapping, a relationship was established between this index and the fractional snow cover. It was also found that including the Normalized Difference Vegetation Index, which has been used for mapping vegetation densities, substantially improved the fit of the curve to the ground-truth in forested areas. The accuracy of this method is estimated at within ±11% for 95% of the pixels.

High, thin cirrus clouds cover a large fraction of the earth's surface every day. These clouds do not completely block light at the wavelengths used for snow mapping, but they

do obscure the signal by increasing or decreasing (depending on the wavelength) the amount of energy received by the satellite. A method has been proposed for the correction of the NDSI and the NDVI for the effects of cirrus clouds. This will allow the snow mapping algorithms to be run in areas where cirrus cloud might have produced substantial errors in the product, and so was not run in previous versions. This correction, developed using MODIS Airborne Simulator Data, uses a relationship between the changes in these indices with increasing reflectance in a 1.889 _m channel. The MODIS instrument does not have a this channel, but its 1.375 _m channel has been demonstrated to be of similar effectiveness at detecting cirrus clouds. Because of a lack of field data, no validation of this correction was possible at this point, but examination of surface features in the image suggests that this method has some promise.

This paper shows that it is possible to map fractional snow cover using a relatively simple relationship using band ratios. The errors that remain are systematic, so corrections should be possible in the future. The paper also suggests a method for correcting both this algorithm and the Snowmap algorithm for cirrus clouds. This correction could substantially decrease the amount of cloud-obscured data in the MODIS snow cover products. Validation of this correction is necessary before it can be implemented.

Other validation efforts – D. Hall

Time series of MODIS snow maps of North America (days 107-111) are being prepared so that a GCM test can be done with Dr. Glen Liston/Colorado State University. Results of the study should quantify the improvement expected using MODIS data versus using simulated snow cover.

Time series of MODIS snow maps of northern and central Alaska are also being prepared for validation work on snowmelt patterns in spring of 2000, with Drs. Carl Benson/Univ. of Alaska and Matthew Sturm/CRREL.

Web site – Kimberly Casey/RDC

The MODIS snow and ice Web site is undergoing a total renovation.